CHAPTER 10

OTHER FLATFISH

by

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EXECUTIVE SUMMARY

The following changes have been made to this assessment relative to the November 2002 SAFE:

Changes in the input data

1) The 2002 catch (total and discarded) was updated, and catch through 20 September, 2003 were included in the assessment.

2) 2003 trawl survey biomass estimates and standard errors of other flatfish species were included in the assessment.

Changes in assessment results

1) A summary of the harvest recommendations for 2003 is compared to the recommendations used in the 2002 assessment is as follows:

	2002 Assessment recommendations	2003 Assessment recommendations
Exploitable biomass	106,739 t	90,327 t
ABC	14,691 t	13,549 t
Overfishing	19,588 t	18, 065 t
F_{ABC}	0.15	0.15
$F_{overfishing}$	0.20	0.20

INTRODUCTION

The Bering Sea/Aleutian Islands "other flatfish" group have typically included those flatfish besides rock sole, yellowfin sole, arrowtooth flounder, and Greenland turbot. Flathead sole (*Hippoglossoides elassodon*) were part of the other flatfish complex until they were removed in 1995, and Alaska plaice was removed from the complex in 2002, as sufficient biological data exists for these species to construct age-structured population models. In contrast, survey biomass estimates are the principal data source used to assess the remaining other flatfish. Although over a dozen species (Table 1) of flatfish are found in the BSAI area, the other flatfish biomass consists primarily of starry flounder, rex sole, longhead dab, and butter sole.

Catch History

The miscellaneous species found in the other flatfish species category are listed in Table 1, and their catches from 1995-2003 are shown in Table 2. These catch estimates were produced by applying the proportional catch , by species, from fishery observer data to estimates of total catch for the other flatfish complex. In recent years, starry flounder (*Platichthys stellatus*) and rex sole (*Glyptocephalus zachirus*) account for most of the harvest of other flatfish, and contributed 85% of the harvest of other flatfish in 2003.

Other flatfish are grouped with Alaska plaice, rock sole, and flathead sole and other flatfish fisheries in a single prohibited species class (PSC) classification, with seasonal and total annual allowances of prohibited bycatch applied to the classification. In recent years, this group of fisheries has been closed prior to attainment of the TAC due to the bycatch of halibut (Table 3).

DATA

Absolute Abundance and Exploitation Rates

The biomass of the other flatfish complex on the eastern Bering Sea shelf has been relatively stable from 1983-1995, averaging 50,200 t, and has slightly increased from 1996 to 2003, averaging 76,100 t (Table 4). The 2003 biomass estimate of other flatfish on the EBS shelf is 90,327 t. Increases in biomass have also been seen in the Aleutian Islands trawl survey; the 2000 and 2002 estimates of 8100 t and 8800 t, respectively, are larger than any previous AI survey estimate. Individual species biomass estimates from 1997-2003 are shown in Table 5. Exploitation rates for starry flounder and rex sole have been low, not exceeding 0.10 from 1997 to 2003 (Table 9). The exploitation rates for butter sole have been slightly higher, exceeding 0.15 in 1997, 2000, 2001, and 2003, but the biomass estimates for butter sole have large sampling variances, with coefficients of variation ranging from 0.5 to 0.64 in recent EBS trawl surveys.

The 2003 survey biomass estimate of butter sole of 179 t is less than one-tenth the 2002 estimate of 2254, and results in an estimated exploitation rate greater than one. However, butter sole were only captured in four hauls in the 2003 EBS trawl survey, leading to the large coefficient of variation in the estimated biomass. In addition, the bulk of the 2003 fishery records come primarily from waters less than 50 m in January and February, a depth and time not covered by the trawl survey. Thus, it is likely that the population of butter sole is larger than that indicated from the survey, and the comparison of survey biomass to harvest should be interpreted accordingly.

Several species of other flatfish are relatively rare on the EBS shelf, including Dover sole, Sakhalin sole, and English sole, and it is useful to identify whether the EBS represents the edge of the distribution for these species. The distribution of English sole has been identified as Baja California to Unimak Island, and the distribution of Dover sole has been identified as from Baja California to the Bering Sea (Hart 1973). Thus, the eastern Bering Sea can be considered the edge of the range for these species, and more significant populations of these species are found in the Gulf of Alaska. For example, the abundance of Dover sole in the 1984-2001 GOA surveys has

fluctuated between 63,000 t and 96,000 t, the abundance of butter sole has fluctuated between 17,000 t and 30,000 t, and the abundance of English sole has fluctuated between 3,000 t and 14,000 t (Turnock et al. 2001). Dover sole and English sole were most common in the eastern portion of the GOA, consistent with their reported distribution along the west coast of North America.

PROJECTIONS AND HARVEST ALTERNATIVES

Reference Fishing Mortality Rates and Yields

Other flatfish are assessed under Tier 5 of Amendment 56 to the BSAI groundfish management plan, and thus require estimates of biomass and natural mortality. The natural mortality rates used in age-structured BSAI flatfish assessments can be used as guidance and are presented below:

Species	Natural mortality rate used for stock assessment
Yellowfin sole	0.12
Rock sole	0.18
Flathead sole	0.20
Alaska plaice	0.25

Given this range of values, an assumption of 0.20 appears reasonable. The estimates of F_{abc} and F_{ofl} under tier 5 are 0.75M and M, respectively, and the ABC and OFL levels are the product of the fishing mortality rate and the biomass estimate. Given the F_{abc} and F_{ofl} levels of 0.15 and 0.20, and the biomass estimate of 90,327 t, the resulting ABC and OFL levels are 13,549 and 18,065 t.

F level (value)	Projected yield for year 2004
Tier 5 F_{ABC} (0.15)	13,549 t
Tier 5 F_{OFL} (0.20)	18,065 t

Summary

In summary, several quantities pertinent to the management of the other flatfish are listed below.

Quantity	Value
M	0.20
Tier	5
Year 2004 Total Biomass	90,327 t
F_{OFL}	0.20
Maximum F_{ABC}	0.15
Recommended F_{ABC}	0.15
OFL	18,065 t
Maximum allowable ABC	13,549 t
Recommended ABC	13,549 t

REFERENCES

Hart, J.L. 1973. Pacific fishes of Canada. Fisheries Research Board of Canada, Bulletin 180, Ottawa. 740 pp.

Spencer, P.D., T.K. Wilderbuer, and C.I. Zhang. 2002. A mixed-species yield per recruit model for eastern Bering Sea flatfish fisheries. Can J. Fish. Aquat. Sci. 59:291-302.

Turnock, B.J., T.K. Wilderbuer, and E.S. Brown. 2001. Gulf of Alaska flatfish. In Stock Assessment and Fishery Evaluation Document for Groundfish Resources in the Gulf of Alaska Region as Projected for 2002. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage Alaska 99510.

Table 1. Flatfish species of the Bering Sea/Aleutian Islands "other flatfish" management complex.

Common Name	Scientific Name
Arctic flounder	*Liopsetta glacialis*
butter sole	*Isopsetta isolepis*
curlfin sole	*Pleuronectes decurrens*
deepsea sole	*Embassichths bathybus*
Dover sole	*Microstomus pacificus*
English sole	*Parophrys vetulus*
longhead dab	*Limanda proboscidea*
Pacific sanddab	*Citharichthys sordidus*
petrale sole	*Eopsetta jordani*
rex sole	*Glyptocephalus zachirus*
roughscale sole	*Clidodoerma asperrimum*
sand sole	*Psettichthys melanostictus*
slender sole	*Lyopsetta exilis*
starry flounder	*Platichthys stellatus*
Sakhalin sole	*Pleuronectes sakhalinensis*

Table 2. Harvest (t) of other flatfish from 1995-2003.

Year	Starry Founder	Rex Sole	Butter Sole	Remaining Species	Total
1995	337	512	163	15	1027
1996	1194	984	219	98	2495
1997	1193	588	492	179	2451
1998	330	775	214	41	1359
1999	756	655	213	16	1640
2000	1012	748	349	20	2129
2001	644	682	198	18	1542
2002	1066	1278	195	31	2570
2003*	1030	1209	367	22	2628

*NMFS Regional Office Report through Sept 20, 2003

Table 3. Restrictions on the "other flatfish" fishery from 1994 to 2003 in the Bering Sea – Aleutian Islands management area. Note that in 1994, the other flatfish category included flathead sole. Unless otherwise indicated, the closures were applied to the entire BSAI management area. Zone 1 consists of areas 508, 509, 512, and 516, whereas zone 2 consists of areas 513, 517, and 521.

Year	Dates	Bycatch Closure
1994	2/28 – 12/31	Red King crab cap (Zone 1 closed)
	5/7 – 12/31	Bairdi Tannner crab (Zone 2 closed)
	7/5 – 12/31	Annual halibut allowance
1995	2/21 – 3/30	First Seasonal halibut cap
	4/17 – 7/1	Second seasonal halibut cap
	8/1 – 12/31	Annual halibut allowance
1996	2/26 – 4/1	First Seasonal halibut cap
	4/13 – 7/1	Second seasonal halibut cap
	7/31 – 12/31	Annual halibut allowance
1997	2/20 – 4/1	First Seasonal halibut cap
	4/12 – 7/1	Second seasonal halibut cap
	7/25 – 12/31	Annual halibut allowance
1998	3/5 – 3/30	First Seasonal halibut cap
	4/21 – 7/1	Second seasonal halibut cap
	8/16 – 12/31	Annual halibut allowance
1999	2/26 – 3/30	First Seasonal halibut cap
	4/27 – 7/04	Second seasonal halibut cap
	8/31 – 12/31	Annual halibut allowance
2000	3/4 – 3/31	First Seasonal halibut cap
	4/30 – 7/03	Second seasonal halibut cap
	8/25 – 12/31	Annual halibut allowance
2001	3/20 – 3/31	First Seasonal halibut cap
	4/27 – 7/01	Second seasonal halibut cap
	8/24 – 12/31	Annual halibut allowance
2002	2/22 – 12/31	Red King crab cap (Zone 1 closed)
	3/1 – 3/31	First Seasonal halibut cap
	4/20 – 6/29	Second seasonal halibut cap
	7/29 – 12/31	Annual halibut allowance
2003	2/18 – 3/31	First Seasonal halibut cap
	4/1 – 6/21	Second seasonal halibut cap
	7/31 – 12/31	Annual halibut allowance

Table 4. Estimated biomass (t) of other flatfish from the eastern Bering Sea and Aleutian Islands trawl survey.

		Area		
Year	EBS	AI	AI percent of total	Total
1982	117,800			
1983	66100			
1984	59,600			
1985	34,600			
1986	39,500			
1987	49,800			
1988	43,800			
1989	49,600			
1990	46,600			
1991	72,400	2,100	2.7	76,500
1992	53,800			
1993	44,400			
1994	54,000	5,500	9.2	59,500
1995	37,800			
1996	60,200			
1997	70,200	7,600	9.8	77,800
1998	73,900			
1999	69,700			
2000	70,500	8,100	10.3	78,600
2001	78,300			
2002	97,900	8,800	8.2	106,700
2003	90,300			

Table 5 --Estimated biomass (t) and coefficient of variation (in parentheses) for the miscellaneous species of the "other flatfish" management complex in the Bering Sea trawl and Aleutian Islands surveys.

Eastern Bering Sea Shelf survey

Year	Dover Sole	Rex Sole	Species longhead dab	Sakhalin sole	starry flounder	butter sole	English sole
1982	--	5994 (0.16)	103806 (0.16)	--	7781 (0.32)	182 (0.82)	--
1983	--	7272 (0.18)	51386 (0.38)	--	7436 (0.25)	37 (0.45)	--
1984	--	13058 (0.28)	35308 (0.16)	137 (0.43)	8913 (0.36)	2231 (0.64)	--
1985	10 (1.04)	10751 (0.20)	9107 (0.13)	102 (0.37)	12181 (0.24)	2421 (0.83)	--
1986	15 (1.00)	12886 (0.22)	10889 (0.14)	274 (0.48)	9112 (0.33)	6341 (0.58)	--
1987	81 (0.91)	12931 (0.19)	11897 (0.19)	110 (0.59)	22702 (0.63)	2043 (0.38)	--
1988	38 (0.59)	15445 (0.15)	16710 (0.19)	253 (0.63)	9222 (0.30)	2083 (0.47)	--
1989	--	12939 (0.15)	13086 (0.16)	58 (0.57)	22205 (0.35)	1304 (0.54)	--
1990	47 (0.58)	11857 (0.21)	18601 (0.15)	110 (0.51)	15048 (0.26)	986 (0.60)	--
1991	55 (0.70)	16014 (0.28)	18680 (0.14)	291 (0.79)	34303 (0.23)	3056 (0.50)	--
1992	137 (0.58)	14001 (0.24)	10827 (0.17)	75 (0.48)	27544 (0.22)	1233 (0.70)	--
1993	37 (0.75)	14567 (0.32)	11690 (0.21)	78 (0.34)	16510 (0.22)	1517 (0.75)	--
1994	73 (0.72)	15943 (0.38)	18533 (0.26)	183 (0.41)	18218 (0.22)	1095 (0.97)	--
1995	--	10420 (0.28)	8402 (0.15)	109 (0.32)	17652 (0.29)	1203 (0.54)	--
1996	--	10532 (0.40)	8567 (0.20)	34 (0.34)	40409 (0.45)	683 (0.53)	--
1997	--	8233 (0.27)	18003 (0.21)	87 (0.49)	41018 (0.21)	2884 (0.43)	--
1998	41 (0.44)	7588 (0.22)	14737 (0.19)	34 (0.49)	49605 (0.30)	1942 (0.38)	--
1999	16 (0.65)	8020 (0.28)	12087 (0.21)	63 (0.29)	43375 (0.25)	4152 (0.62)	--
2000	11 (1.02)	9348 (0.19)	13511 (0.30)	145 (0.88)	45810 (0.19)	1713 (0.56)	--
2001	16 (0.84)	21660 (0.23)	12764 (0.26)	31 (0.43)	43026 (0.25)	796 (0.50)	--
2002	7 (0.80)	26053 (0.20)	9740 (0.22)	7 (0.69)	59877 (0.23)	2254 (0.64)	--
2003	350 (0.66)	28023 (0.15)	8827(0.22)	55 (0.40)	52893 (0.17)	179 (0.61)	

Aleutian Islands Surveys

Year	Dover Sole	Rex Sole	Species longhead dab	Sakhalin sole	starry flounder	butter sole	English sole
1991 AI	174 (0.45)	1694 (0.18)	--	--	142 (0.85)	86 (0.73)	47 (0.80)
1994 AI	438 (0.41)	4306 (0.15)	--	--	134 (0.69)	505 (0.98)	83 (0.81)
1997 AI	386 (0.34)	6378 (0.16)	--	--	459 (0.90)	346 (0.98)	12 (0.72)
2000 AI	630 (0.38)	6526 (0.18)	--	--	590 (0.71)	310 (0.99)	95 (0.97)
2002 AI	575 (0.28)	7381 (0.15)	--	--	671 (0.72)	127 (0.83)	47 (0.94)

Table 6. Estimated exploitation rates of rex sole, starry flounder and butter sole from 1997 to 2003.

	Rex sole			Starry Flounder			Butter sole		
Year	Biomass (t)	Harvest (t)	Exp. Rate	Biomass (t)	Harvest (t)	Exp. Rate	Biomass (t)	Harvest (t)	Exp. Rate
1997	14611	588	0.04	41477	1193	0.03	3230	492	0.15
1998	7588	775	0.10	49605	330	0.01	1942	213	0.11
1999	8020	655	0.08	43375	756	0.02	4152	212	0.05
2000	15874	748	0.05	46400	1012	0.02	2023	349	0.17
2001	21660	682	0.03	43026	644	0.01	796	198	0.25
2002	33434	1278	0.04	60548	1066	0.02	2381	195	0.08
2003	28023	1209	0.04	52893	1030	0.02	179	367	2.05